NATIONAL EXAMINATION, DECEMBER 2014

04-ENV-A4-Water and Wastewater Engineering

3 hours duration

Notes:

1. Question 1 is compulsory, attempt any three questions from the remaining four questions.
2. If doubts exist as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
3. This is a closed book exam. However, one aid sheet is allowed written on both sides.
4. An approved calculator is permitted.
5. Marks of all questions are indicated at the end of each question.
6. Clarity and organization of answers are important.

Q1 (25 marks)
Define and explain the following terms in water and wastewater engineering

    i. "Population equivalent" in wastewater treatment **(5 marks)**
    ii. Oxygen sag curve in stream pollution **(5 marks)**
    iii. MLSS and MLVSS **(5 marks)**
    iv. Disinfection by-products **(5 marks)**
    v. Turbidity in water **(5 marks)**

Q2 (25 marks)
    i. Explain the significance of chlorides sulfates and nitrates in drinking water quality. Briefly explain the principals of measuring chlorides and sulfates in water. **(15 marks)**
    ii. Explain the principal of ozonation for disinfection of water. Give two advantages and two disadvantages of ozonation over chlorination for disinfection **(10 marks)**

Q3 (25 marks)
    i. Define pH and explain its significance for water treatment with special regards to disinfection and coagulation-flocculation. **(10 marks)**
    ii. 50 mL of a water sample required 5 mL of 0.02N H_2SO_4 to reach the end point with phenolphthalein as indicator (pH 8.3), and 8 mL of 0.02N H_2SO_4 to reach the end point with Bromocresol Green (pH 4.5). Name the type of alkalinity indicated by each of these end points and determine the value of each alkalinity. Also what other type of alkalinity value can you calculate from these two observations, and what is its value? **(15)**

Q4 (25 marks)
    i. Define and differentiate between
        a. Aerated and facultative lagoons **(6 marks)**
        b. Organic, Poly and Ortho Phosphorus **(6 marks)**
        c. Total Nitrogen, TKN and Ammonia-Nitrogen **(7 marks)**
        d. HRT and SRT in Biological treatment systems **(6 marks)**

Q5 (25 marks)
Primary clarifier of an activated sludge system treats an average day flow of 10,000 m^3/d with TSS, VSS and BOD_5 of 200 mg/L, 170 mg/L and 160 mg/L respectively. If the TSS removal efficiency of the clarifier is 60%, calculate the following;

    I. TSS, VSS and BOD_5 loads in primary effluent. Assume appropriate BOD_5 removal for the given TSS removal in the clarifier. **(7 marks)**
    II. Volume of primary sludge produced per day, assuming a solids concentration of 4% and specific gravity of 1.03. **(6 marks)**
    III. Surface area of the primary clarifier for a surface overflow rate of 60 m^3/m^2-d at peak day flow, assuming a peaking factor of 2.25. **(6 marks)**
    IV. HRT at average day flow if the side water depth of the clarifier is 3.0 m. **(6 marks)**